

ABSTRACT

Sport climbing heavily relies on physical endurance, particularly involving the muscles of the arms, shoulders, and core. This activity requires strength and balance to overcome gravity, making muscle fatigue a key factor that can reduce climbers' performance. This study aims to evaluate the endurance performance of the Flexor Carpi Radialis and Deltoideus muscles in recreational climbers by measuring Surface Electromyography (sEMG) signals and lactate levels as indicators of muscle fatigue. A longitudinal experimental design was employed with participants aged 18 to 25 years climbing a grade 7A+ route. Repeated measurements of sEMG data and lactate concentrations were collected over multiple climbing trials.

Statistical analysis using Two-Way Repeated Measures ANOVA assessed the interaction effects between trial and gender (male and female) on muscle performance. Additionally, a Correlation test was conducted to examine the relationship between the activities of the Flexor Carpi Radialis and Deltoideus muscles during climbing. Results showed significant differences in Root Mean Square (RMS) and Lactate Difference Value (LDV). Although the ANOVA analysis did not find significant differences between trials for the Combined Muscle ($p > 0.05$), a trend was observed in the Deltoideus muscle based on trial ($p = 0.089$). The p -value of 0.029 for the Combined Muscle was found for significant gender differences in the RMS feature, not for trial differences. Lactate levels showed significant differences across trials ($F = 7.11$, $p = 0.0262$), with post-hoc tests indicating significant differences between trials 1 and 3 ($p = 0.031$) and between trials 2 and 3 ($p = 0.045$). Significant gender differences were also found in the RMS feature of the Deltoideus muscle ($p = 0.029$), with males exhibiting greater strength. These findings are important for training management based on sEMG and lactate data to improve muscle endurance and climbing performance while considering physiological differences between genders.

Keywords: *Wall Climbing, Anaerobic Muscle Endurance (Stamina), Flexor Carpi Radialis, Deltoideus, Surface Electromyography (sEMG), Two-Way Repeated Measures ANOVA, Correlation Test.*